Al-Mustaqbal University
Collage of Engineering
Prosthetics and Orthotics Engineering

Third Stage

2st term

2025/2026

Prosthetics III

(UOMU0103061)

Lecture 2

Asst. Lect. Muntadher Saleh Mahdi

Muntadher.saleh.mahdi@uomus.edu.iq

University of Kerbala
College of Engineering
Prosthetics and Orthotics Engineering

Subject: Prosthetics 3
Lecturer: Samer Aswad Alsaeedi
sameralaseedi@gmail.com

Lecture 1

UPPER-EXTREMITY PROSTHETIC COMPONENTS

1. Replacement Mechanisms for Lost Functionalities

- **Terminal Devices (TD)** Primarily employed to replicate the functions of grasp and release that a natural hand or digits would afford.
- **Elbow Mechanisms** Catering to the need for humeral-ulnar articulation, which in simple terms, refers to the joint movement between the upper arm and the forearm.
- **Shoulder Mechanisms** Positioned proximally, these are crucial for maintaining the orientation of the humerus in space. This becomes even more critical at the shoulder disarticulation and scapulothoracic amputation levels.
- **Rotators** The intricacy of human movement is not just in primary joint functions but also in rotations. Hence, rotators can be integrated into the forearm of the prosthesis to substitute for actions like pronation and supination. Above the elbow unit, these rotators compensate for the internal and external rotation of the shoulder.

2. Innovations in Hand, Wrist, and Transcarpal Prosthetics

Traditionally, patients with partial hand or transcarpal amputations were primarily offered cosmetic prosthetics, which while aesthetically pleasing, did not restore function. However, the technological renaissance of our age has transformed this narrative. With advances in microprocessors and technology:

- **Externally Powered Options** These prosthetics, as seen in Figure , allow electric control even for extremely distal amputation sites.

Subject: Prosthetics 3
Lecturer: Samer Aswad Alsaeedi
sameralaseedi@gmail.com

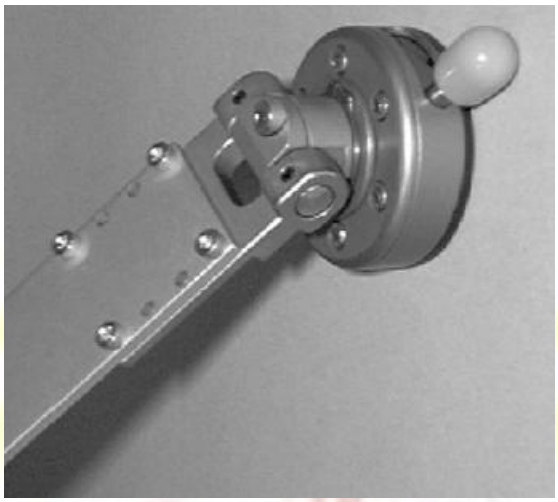
- **Preoperative Considerations** The surgeon must be judicious, considering the functionality of any remaining digits, particularly their sensation and mobility. This dictates whether a more proximal amputation is requisite.
- **Wrist Disarticulation and Challenges** The residual limb following wrist disarticulation offers a formidable lever for prosthetic utility. However, a challenge arises in achieving the balance between functional utility and cosmetic acceptability, especially considering the space required to accommodate wrist and hand units.

3. Transradial and Transhumeral Prostheses

These are classifications based on the amputation levels

- **Space Requirements** Prostheses for adults demand space beyond the residual limb. For transradial prostheses, approximately 8 inches are necessary for the prosthetic wrist rotator and TD or hand. Similarly, the transhumeral level requires roughly 6 inches beyond the residual limb.
- **Challenges with Short Residual Limbs** With a short residual humerus, traditional prosthetic systems might be unfeasible. Such cases may require treating a transhumeral amputation akin to a shoulder disarticulation, as showcased in Figure.

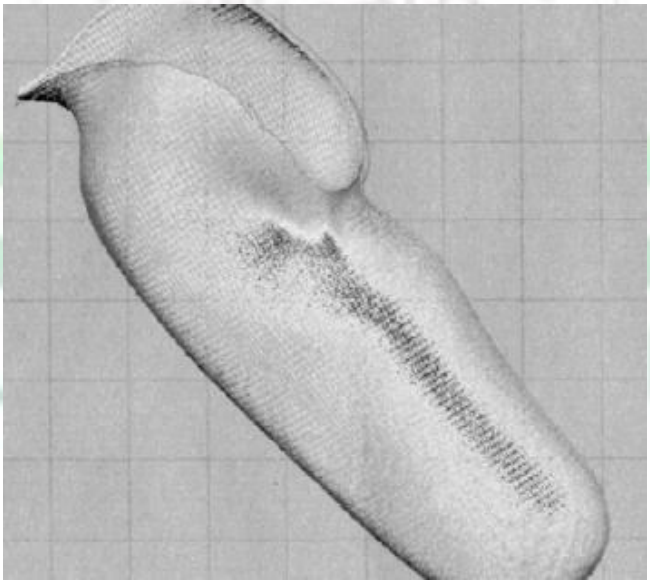
Subject: Prosthetics 3
Lecturer: Samer Aswad Alsaeedi
sameralaseedi@gmail.com



4. Prosthesis Fabrication in the Modern Era

Advancements in fabrication techniques, paired with the digital age's innovations, have refined the process:

- **Plaster Direct Molding Techniques** A tried and tested method that is still relevant and effective today.
- **Computer-Aided Design (CAD)** Revolutionizing prosthesis fabrication, CAD permits accurate modeling and data collection, as depicted in the Figure. Such technology allows for the optimization of the fit and function of the prosthetic, catering to individual needs.



Subject: Prosthetics 3
Lecturer: Samer Aswad Alsaeedi
sameralaseedi@gmail.com

Pre-prosthetic Care for Upper-Extremity Amputation

1. Foundations of Preprosthetic Care

- **Post-surgery Care** The two pillars are wound healing and pain management.
- **The Multidisciplinary Approach** An interdisciplinary team, consisting of the prosthetist, surgeon, nurses, therapists, counselors, among others, ensures the most effective care.

2. Edema and Volume Control

- **The Importance** Edema and volume control are fundamental in preprosthetic care.
- **Methods** Compressive wraps or shrinkers are recommended as soon as possible post-surgery. Multidirectional shrinker garments have been proven to be superior to alternatives, including elastic bandages.
- **Efficiency of Shrinkers** They are efficient in controlling volume, shaping the residual limb, and resisting shift. They also excel at establishing a consistent pressure gradient from the distal to the proximal end.
- **Custom Fabrication** For transhumeral amputation, custom fabrication might be necessary for producing a shrinker with a modified shoulder cap.

3. Skin Care, Desensitization, and Range of Motion

- **Challenges** Traumatic amputations, especially those with associated skin grafts, pose significant challenges in skin care.
- **Desensitization and Limb Maturation** The volume management protocol, by its nature, initiates desensitization and limb maturation.
- **Ideal Residual Limb Characteristics** It should be long enough for functional usage but not excessively long that it limits prosthetic component options. Limbs with effective myodesis often display reduced myoelectric artifacts.

Subject: Prosthetics 3
Lecturer: Samer Aswad Alsaeedi
sameralaseedi@gmail.com

4. Blast and Percussion Injuries

- **Complexities** Such injuries can bring forth intricate socket interface and electrical conductivity problems.
- **Tissue Behavior** Blast injuries create a unique tissue consistency, reacting more intensively to external compressive forces than other types of injuries. This behavior mandates meticulous planning in rehabilitation.

5. Range of Motion (ROM) and Strengthening

- **Significance** Maximizing preprosthetic ROM is imperative irrespective of the planned prosthetic approach.
- **Global Strengthening Approach** A holistic approach accelerates and completes rehabilitation. The focus should not just be on the primary movers but also on the secondary and accessory stabilizers.